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Arvind Kumar
Forest Research Institute,
New Forest, Dehradun, India

RS Prasad
Institute of Forest Productivity,
Lalgutwa, Ranchi, India

Ombir Singh
Forest Research Institute,
New Forest, Dehradun, India

Correspondence
Arvind Kumar
Forest Research Institute,
New Forest, Dehradun, India

Comparative study of two bushy lac insect host plants *Flemingia semialata* Roxb. ex W.T. Aitonand *Flemingia macrophylla* (Wild.) Merr. and lac insect performance

Arvind Kumar, RS Prasad and Ombir Singh

Abstract
Flemingia spp. are very promising species for lac cultivation in India. The present study was conducted to find out the best performing species between *F. semialata* and *F. macrophylla* for lac cultivation. It was resulted that seed size, viability and germination of *F. semialata* was greater as compared to *F. macrophylla*. Subsequently, lac insect survival per cent (92.51%) and scrap lac (30.77gm) was found to be more in *F. semialata* as compared *F. macrophylla* (62.84%) and (26.36 gm), respectively. While, the plant growth of *F. macrophylla* was found to be faster, with more branching and crown development. Hence, these findings indicated that *F. semialata* is a better option for sustainable lac insect rearing and more lac recovery and farmer's benefit point of view.

Keywords: *Flemingia semialata*, *Flemingia macrophylla*, seed germination, insect survival, insect settlement

1. Introduction

Lac is an important natural resin of economic importance, secreted by tiny lac insects, *Kerrialacca* (Kerr).This insect has about 113 host plant species and complete its lifecycle successfully [1], among these, only three traditional host plant species *viz*., Kusum (*Schleichera oleosa*), Palas (*Butea monosperma*) and Ber (*Ziziphus mauritiana*) are in used for commercial lac cultivation [2]. The major lac cultivating states of India are Jharkhand, Chhattisgarh, West Bengal, Madhya Pradesh and Orissa [2] and these states has the maximum traditional lac host plants, but the populations of above traditional lac hosts plants have considerably declined due to rampant deforestation and their poor management in last three decades. Subsequently, the lac production of India has declining and to increase the lac production of India, the population of host plant has to be increased [3]. Though, the establishment of new plantations of these traditional lac host species is very difficult due to their slow growth and social un-acceptance. Additionally, crop management, lac cultural operations, lac crop protection and harvesting is very difficult in these traditional lac host plants due to their tall height and big crown development. Hence, the lac cultivation and lac production can be increased only by adoption of new fast growing hosts which hasa low gestation period such as *Flemingia semialata* Roxb. ex W. T. Aiton and *Flemingia macrophylla* (Willd.) Merr. Withs cientific approaches [3]. These both the species of *Flemingia* are grown for lac cultivation and they are emerged as important lac hosts in the country. These species are highly suitable for production of good quality of kusumilacunder irrigated conditions. Both the species attain very short height and can be used for the purpose of intercropping with different crops to earn additional income [4]. These species can be grown in soil having a medium fertility, partial sloppy land with degraded soil of low fertility and slightly acidic soils. Farmers start getting benefits in extremely short time as lac inoculation is possible on one year old plants. Additionally, nitrogen fixing and the soil conservation ability [5] of both the species make them more suitable for cultivation. In view of the growing interest of farmers in intensive cultivation of *Flemingia* for lac production and availability of scanty information, seed characteristics, germination and plant growth of both species need to be studied for attainment of optimum benefit. Therefore, the present study was carried out to compare the seed characteristics, plant growth and lac development on *Flemingia semialata* and *Flemingia macrophylla.*

2. Material and Methods

The present investigation was carried out at research campus of Institute of Forest Productivity (IFP) Ranchi, India in the year 2013.The institute is situated at latitude $23^0$21'26"N, longitude $84^0$14'44". The soil of experimental area was laterite soil. The average temperature of the region is 25°C, but the lowest temperature may fall upto5 °C in winter and in summer it may rise up to 40 °C. The annual rainfall in the region is between 1200 mm to 1800 mm and the main rainy months are June to September [6]. Seeds of both the species were obtained from Indian Institute of Natural Resin and Gum, Ranchi. After visual observation for colour, purity was determined on seed illuminated purity board. Seed weight was taken per 1000 seed of each species. Initial moisture content was recorded by the seed moisture meter. Length and width of the seeds was examined with digital vernier caliper taking 10 seeds of each species and then aspect ratio was calculated. Before the germination test physical testing of both species were carried out as per ISTA guidelines such as floating, colour and cutting test. For germination testing25 seeds were placed in petridish having moist blotting paper at controlled condition of 28±0.5 ^{0}C temperature and 70±5% RH. Seeds of uniform size and colour were used for the experiment and replicated three times. Moisture content in the petridish was maintained time to time by spraying water.

Seed germination test of both the species was also evaluated in field condition. Single seed was sown in each poly bags filled with mixture of soil, sand and FYM at 2:1:1 ratio both the species in the first week of June, and replicated ten times. Sprouting of seed was noticed from the seventh day of sowing and germination percent was calculated based on total seedling emergence up to twenty days of sowing.

One month old seedlings were transplanted in the month of August, 2012and the plant growth data was recorded after one year in the month of July of the subsequent year. Subsequently, brood lac was inoculated in the month of July @ 20gm per plant for lac production study. After 60 days of inoculation settlement of lac insect and their survival data was recorded. After two months of interval total settlement of lac insect on the shoot and mortality data was recorded. Similarly, after six months of inoculation lac was harvested by cutting the plants at 6 inches of ground level. Subsequently, brood lac, stick lac and scrap lac and shell weight was recorded. The observed data was analyzed for ANOVA through simple statistics using SPSS-18 software and mean and slandered deviation was quantified.

3. Results and Discussion

3.1 Laboratory test

Different seed parameters were compared under laboratory condition (Table 1) and found that, both the species were bearing pods. The color of *F. semialata* seed was light black, while *F. macrophylla* bearing dark black color seeds and the seed size of *F. semialata* was greater than *F. macrophylla*. The initial moisture content (8.2%), seed viability (73.0%), germination per cent (70.0%) was greater, while, shorter germination period (12 days) was recorded in *F. semialata*. The seed size of *F. semialata* was found more and therefore 1000 seed weight was also more (22.50g) as compared to *F. macrophylla* (18.20g.).A study conducted by [7] on seed germination test of *F. macrophylla* and found best cumulative germination (89.2%) was after soaking in sulfuric acid for 10 or 15 min against the control (50.4%), which confers the result of the present study.

3.2 Fieldtest

In the field condition it was found that, the germination of *F. semialata* was only 65.0% while, in *F. macrophylla* it was observed 74.8% (Fig. 1.). After 30 days of sowing shoot length was 16.8 cm in *F. semialata* and 21.2 cm was observed in *F. macrophylla*. The root length of *F. semialata* was 10.7 cm while, in *F. macrophylla*11.7 cm root length was recorded.

3.3 Plant growth and lac recovery assessment

The result (table 2) showed that plant growth of *F. macrophylla* was 228.67 cm and of *F. semialata* was 138.22 cm after one year of transplanting.

The brood lac production was recorded 533.94 g in *F. macrophylla* and 294.44 g in *F. semialata*. Stick lac production was 302.01 g in *F. macrophylla* and 105.42 g in *F. semialata*. Scrap lac was recovered 26.36g in *F. macrophylla* and 30.77 g in *F. macrophylla*. The shell weight was recorded 0.0451 g in *F. macrophylla* and 0.0442 g in *F. semialata*. The similar annual plant growth of *F. semialata* and lac the recovery pattern was also recorded by [8].

Lac insect settlement and survival based was also observed (Table 3) and found that total 90.50 insect were settled per cm of shoot area, among these 56.50 insects were found live and only 62.84% insects were found to survive after two months of inoculation in *F. macrophylla*. While, in *F. semialata* 109.16 insects were found settled per cm of shoot area, out of these 100.70 insects were found live after two months of inoculation and total 92.51% survival was recorded. This result is with conformity of the findings of [9, 10] and in which they argued that lac insect survival and lac recovery in *F. semialata* was more as compared to *F. macrophylla*.

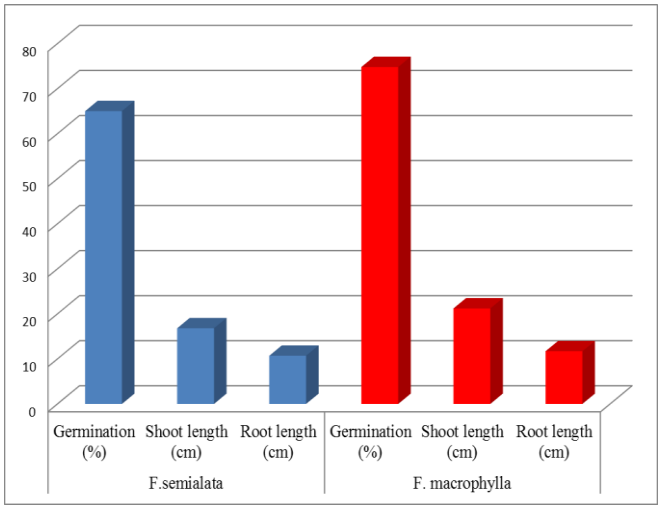

Fig 1: Seed germination and initial growth test in field condition

Table 1: Seed parameters study of *F. semialata* and *F. macrophylla*

Traits	Feature	*F. semialata*	*F. macrophylla*
Phenology	Fruiting period	Jan-March	September-January
	Best time of collection	March- April	November- December
Appearance	Fruit type	Pod	Pod
	Colour	Gray/ Light black	Dark Black
Dimension	Length(mm)	0.36 cm	0.32 cm
	Breath	0.35 cm	0.30 cm
	Aspect ratio	1.02	1.06
Weight	1000 seed weight (g)	22.50g	18.20g
	Seeds per kg	44440	54945
Initial status	Moisture content (%)	8.2	8.0
	Viability (%)	73.0	70.0
Purity	Purity (%)	95.0	96.0
Germination	Germination (%)	70.0	60.0
	Germination period (days)	12.0	15.0
Storage	Nature	Orthodox	Orthodox
	Retention of viability (Month)	24.0	24.0
	Optimal temperature (^{0}C)	4.0	2.0-4.0

Table 2: Plant growth and lac production parameters (per plant) in *F. macrophylla* and *F. semialata.*

Host species	***F. mcrophylla*** (mean±SD)	***F. semialata*** (mean±SD)
Plant height (cm)	228.67±26.34	138.22±16.87
Brood lac (g)	533.94±54.85	294.44±35.45
Stick lac (g)	302.01±22.64	105.42±18.64
Scrap lac (g)	24.36±6.21	40.77±4.51
shell weight (g)	0.0451±0.0004	0.0442±0.0004

Table 3: Lac insect population and survival based on settlement (per cm^2) after 60 days of inoculation.

Host species	***F. macropylla*** (mean±SD)	***F. semialata*** (mean±SD)
Total insects (No.)	90.50±30.67	109.00±16.87
Live insect (No.)	56.50±18.95	100.70±15.91
Dead insect (No.)	34.00±13.3	9.00±5.67
Survival (%)	62.84±5.77	92.51±5.91

4. Conclusion

It may be concluded that *F. macrophylla* is a hardier species hence the plant growth and crown development was found to be faster and more as compared to *F. semialata*. Due to less stick recovery in *F. semialata* proves that this species is more succulent and hold more sap content which favors to the lac insect for their better settlement, more survival, feeding and their development. Hence, it may be concluded that *F. semialata* species is more suitable for lac cultivation.

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